RESTORATION OF THE WIRE MACHINE AT

FELIN GANOL, LLANRHYSTUD

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Introduction

Felin Ganol is well known to the Welsh Mills Society but a word or two of introduction is necessary for other readers.

The grist mill last worked in the early 1960s but probably produced very little after 1959. It was purchased by us, the current owners, in 2006 and restoration began soon after that. The early stages of restoration were speculative, not knowing what would eventually work and whether we could learn how to produce decent flour. Major restoration work was needed to rebuild the weir, excavate the leat and pond, repair the waterwheel and refurbish most of the mechanical components inside the mill. A good deal of structural woodwork was also necessary. In 2014 the mill is operating as a small family business producing a variety of organic flours using locally produced grain whenever possible. More details about the mill can be found on its website www.felinganol.co.uk

After a couple of years of milling wholemeal flours the demand for white flour became increasingly apparent and we had a long, hard look at what remained of the wire machine. Wire machines are basically mechanical sieves which use rotating brushes inside a long cylinder to sieve wholemeal flour through various sizes of wire mesh. They are often referred to as flour dressers or incorrectly as bolters. Bolters sieve flour by centrifugal action through a rotating cylinder or 'reel' of cloth and do not use brushes. Although technically intact our wire machine did not look promising since the ravages of time had made it unfit for food use. The flour hopper was rotten and impossible to restore as was the cylinder and wire mesh. The integrity of the whole structure was questionable but it did look as though the external tongue and groove casing was more or less solid.

The wire machine at Felin Ganol seems to be a fairly typical example although dating it is not easy. The cylinder is about 5 feet long and has three grades of wire mesh which produce fine white flour, middlings and semolina; bran comes out of the end of the cylinder as it is too coarse to fall through the largest mesh size. The definitions of middlings and semolina are confusing and complex. Some sources define semolina as only the middlings from durum wheat, and state that 'semolina' from softer wheats is really just another form of flour. It could be argued that Felin Ganol semolina falls into the latter category and that the middlings are just a slightly less fine white.

The drive train for the wire machine starts with a bevel pinion gear which slides along a shaft to engage with the pit wheel. On the same short shaft a 29 inch wood-rimmed pulley takes a vertical belt drive to a 12 inch wooden pulley on a long layshaft which spans the mill at the level of the sack hoist. Next to this pulley is a 28 inch iron one which takes a belt back downstairs to the 7 inch pulley on the wire machine. At the other end of the long layshaft is a curious cog which appears to do nothing unless it was intended as a flywheel of sorts. Most of the other machinery in the mill took power from a layshaft driven from a crownwheel and pinion arrangement on the mainshaft .

In the paper "The watermills of Montgomeryshire" by David H. Jones (Melin 27) the distinction between English and Welsh spurwheel –geared mills is made. Felin Ganol appears to be a hybrid type with drives for small machines taken from both above and below the hurst.

PLATE 1 Repairs to rim of lower pulley

The wire machine rested on rotten pieces of oak laid on the rough stone floor which was very wet when we first arrived at the mill. The main reason for this was a blocked drain which ran under the floor from the old entrance to the mill and directly under the wire machine. This drain may date from the building of the kiln which filled the gap between the mill and the mill house and which would have been the natural way for water from the yard to drain to the tail race. Whatever its history, clearing the drain succeeded in drying out the floor. The wire machine had become integral to the mill structure since it supported the beams which had been cut to accommodate the flour hopper. This meant that making good the oak supports was an essential first step.

PLATE 2   Original oak support at front of machine

PLATE 3   Repairs to oak support in progress

PLATE 4 The cylinder with its mesh was only going to be useful as a template for new items

It was evident that in order to satisfy the demands of health and hygiene, the only part of the interior that could be salvaged was the cast iron shaft. This had also had a hard life since one of the arms had broken off in the past and had been bracketed and bolted back on. It was a solid enough repair but we were concerned that the extra weight of the bracket might throw the shaft out of balance at high revolutions. Both bearing blocks needed to be refurbished and this work was entrusted to Llyr Engineering. Llyr himself has a keen interest in our industrial heritage and has done other work that we were not equipped to undertake ourselves including a new mace and rynd for one of our sets of burr stones. When Llyr tested the shaft for balance in his lathe another arm flew off, fortunately not injuring him. The shaft was out of true, probably the result of being dropped, but Llyr was able to straighten it to acceptable tolerances.

PLATE 5

Bearing blocks: before and after restoration

The interior of the machine was an uninviting spectacle so after a thorough clean the entire surface was lined with ply and then sealed with a food safe oil.

PLATE 6   Repairs to the interior

One of the biggest challenges, apart from the temperature in the mill in December 2010, was constructing the new cylinder which consists of two halves bolted together. The mesh was held in place by strips of metal tacked to the curved supporting pieces. This construction was replicated by using thick ply pieces sawn into shape on a bandsaw. Stainless steel strips and screws rather than tacks were used to attach the mesh, partly for the sake of hygiene but also to make re-meshing easier. Judging from the battered appearance of the original wooden cylinder sections it had been re-meshed on several occasions in the distant past. This must have been a horrible job as it was virtually impossible to pull the tacks neatly out of the wood and the original mesh was so rusted that it was difficult to establish the mesh sizes. We decided on 70 holes to the inch for the top six sections, 60 for the next four and 32 for the last two sections where the semolina comes through. This is a fair approximation of the original but I suspect that 70 mesh is rather finer than what was originally used. John Stanier & Co in Manchester supplied the mesh and also re-bristled the new ash brush backs which we made. They were however unable to duplicate the original method of retaining the bristles in a groove with tensioned wire which required a special machine. Instead the bristles are glued in bunches into a series of holes. Some of the old mill bills that were lying around the mill also bore the maker's stamp of John Stanier; it is remarkable that the same company can still supply items for traditional mills.

PLATE 7 Cylinder under construction

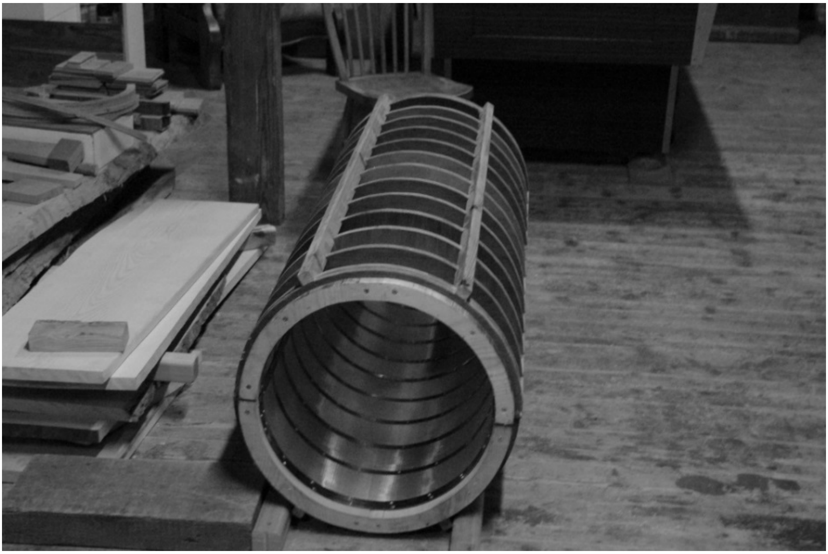

PLATE 8   Cylinder complete

It soon became apparent that the accuracy of the semi-circular wooden mesh supports is critical if the brushes are to maintain an even clearance when rotating. The brushes can be individually adjusted as they are bolted to the spokes but making repeated adjustments with a heavy spanner at arm's length without damaging the mesh is not a job for the faint hearted. All joints had to be tight and as accurate as possible to facilitate cleaning and to avoid accumulation of old flour in any inaccessible crevices. Drilling dozens of screw holes in stainless steel strip with a hand held drill is definitely an exercise to be avoided. A pillar drill would have been a sensible investment at this stage.

The flour hopper was evidently constructed to match the hole in the floor and the position of the wire machine below, resulting in a very peculiar shape. It was an elegant construction but extremely difficult to copy. Some idea of its asymmetry may be gleaned from the following photograph.

PLATE 9 Flour hopper

The tongue which shakes the flour into the cylinder is visible in the above photograph and is rattled by a cam on the rotating shaft. Attached to the underside of the tongue is a wedge of hardwood which would no doubt be replaced when worn too thin to provide enough movement in the tongue. Perhaps one mistake we made was to align the grain of this (mahogany) wedge the wrong way. It would wear more slowly if the grain was aligned with the direction of the cam. Having said that, there is not a great deal of wear after 3 years and several tons of flour sieving and as it is screwed on rather than glued or nailed, it is easily replaced.

On the original cylinder there was no seal of any sort to prevent flour escaping around the drive shaft behind the tongue of the hopper into the area of the pulley and belt. Whether there ever had been such a seal is debatable but judging from the accumulation of ancient flour deposits in this area it seems unlikely. A plywood seal which fitted closely around the shaft was improvised to minimise problems in this area. All this does make one wonder how they ever managed in the old days without vacuum cleaners.

With the machine reassembled we now had to see if it worked at all. As found, the belts in the drive train were not fit for service. The one from the lower pulley to the upper was an ancient leather affair and beyond repair. A balata belt ran down from the upper pulley to the machine. Fortunately the mill loft provided some ancient but unused rolls of balata belt along with a motley collection of belt fasteners and even the original patent fastening tool. Tensioning the belts was an acquired skill but before long the drive train appeared to be functional once more. There followed a disheartening period when all efforts to avoid belt slippage seemed doomed to failure. With the high gearing 12 rpm on the waterwheel results in about 250 rpm on the sieve, the slightest increase in brush pressure would cause slippage. The problem was finally traced to the upper bearing shell on the lower pulley block which was worn out. Surprisingly, when tension is taken up in the belts the lower pulley tries to climb up the belt putting pressure on the upper shell rather than the lower. Another consultation with Llyr and a refurbished bearing block later, we were back in business. Chronic lack of lubrication seems to be a regular cause of mechanical failure in this mill, some bearings were worn down to the blocks with non-existent shells. This would seem to indicate a dwindling interest in maintenance as the mill slowly ceased to function after the last war.

We have referred to brush pressure earlier on and initially thought that in order to sieve effectively the brushes should press evenly and gently on the cylinder. Too much pressure is likely to damage the mesh. Judging by the wear on old brushes left around the mill, or used for improvised roof repairs, the brushes were in quite firm contact with the mesh in the old days. Some were completely worn out. After various experiments with a variety of flours and after many uncomfortable sessions with the adjusting spanner we have found that it is not necessary for the brush to actually touch the mesh in order to achieve good results. Whether our wire machine is typical or not we cannot say but the throughput and quality of the sieving is not improved with increased brush contact. The agitating action of the brushes seems sufficient to drive the flour through the mesh without any brushing action. It seems likely that plastic strips would work equally well and would be a lot easier to clean if not authentic. If we were to suggest another improvement to the sieve it would be to extend the lower (32 mesh) section so that the semolina and bran separation is more effective. If we wish to have complete separation of these by-products then we sometimes have to re-sieve the bran. Longer flour dressers are we believe considered to be more efficient but, in small mills such as ours, space would always have been a major consideration.

We run the flour dresser at about 250 rpm which is coincidentally comfortable for 4ft 6" mill stones turning at about 70 rpm and it sieves flour at roughly the same rate that it is milled, about 1 Kg (2.2 lbs) per minute.